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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/038,204	12/21/2001	Daniel T. Colbert	11321-P011C1D3	1758

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EXAMINER	
LISH, PETER J	

ART UNIT	PAPER NUMBER
1754	

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9

Please find below and/or attached an Office communication concerning this application or proceeding.

CLD 9

Office Action Summary	Application No.	Applicant(s)	
	10/038,204	COLBERT ET AL.	
	Examiner	Art Unit	
	Peter J Lish	1754	

-- The MAILING DATE of this communication appears on the cover sheet with th correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 July 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *84-140* is/are pending in the application.

4a) Of the above claim(s) *84-111* is/are withdrawn from consideration.

5)☒ Claim(s) *125,135,138 and 140* is/are allowed.

6)☒ Claim(s) *112-124,126-133,136,137 and 139* is/are rejected.

7)☒ Claim(s) *134* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4,7* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 84-111, drawn to a method of forming an array of nanotubes, classified in class 423, subclass 447.1.

II. Claims 112-140, drawn to an array of nanotubes, classified in class 423, subclass 447.2.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product can be made by another and materially different process, such as aligning by an electric or magnetic field.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Ross Garsson on September 9th, 2003, a provisional election was made with traverse to prosecute the invention of Group II, claims 112-140. Affirmation of this election must be made by applicant in replying to this Office action. Claims 84-111 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 139 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is unclear what is meant by "different types of single-walled nanotubes".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 112-119, 122-124, 126-132, and 136-137 are rejected under 35 U.S.C. 102(a) as being anticipated by Kiang et al. ("Carbon Nanotubes With Single-Layer Walls") with Zhang et al. ("Microscopic structure of as-grown single-wall carbon nanotubes by laser ablation") to show a state of fact.

Kiang teaches that single-walled nanotubes tend to aggregate into bundles. The nanotubes in a bundle run substantially parallel to one another (see Figure 2c). Zhang teaches that the tubes have a homogenous diameter and are packed into a two-dimensional triangular lattice (section 3.2 – "Bundle structure"). It is inherent to the bundled single-walled nanotubes that they have a homogenous diameter. No difference is seen between the bundles of Kiang et al. and the arrays of the instantly claimed invention.

Regarding claims 124 and 126-132, Kiang teaches that the as-grown nanotube bundles are found growing from metal carbide particles, deposited on chamber walls, deposited as a film on the cathode of an arc-discharge apparatus, grown on the cathode tip of an arc-discharge apparatus, and grown on graphite (pages 903-904). Any of the above may be viewed as a substrate to which the nanotube bundles are attached.

Regarding claims 116-119 and 129-132, Kiang teach the existence of bundles of relatively short single-walled nanotubes having lengths of only 10 to 100 nm (page 905, column 2).

Regarding claims 122-123 and 136-137, It is held that a nanotube must be of the (n, n) or (m, n) helicity index. A mix is expected to occur due to what is known about growth conditions; bundles of predominantly (n, n) as well as bundles of predominantly (m, n) are therefore expected to occur.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 124, 127, and 136-137 are rejected under 35 U.S.C. 103(a) as being unpatentable over de Heer et al. ("Aligned Carbon Nanotube Films: Production and Optical and Electronic Properties").

De Heer et al. teaches a method for the alignment of carbon nanotubes in a substantially parallel orientation. The method is based on drawing a suspension of nanotubes through a small pore ceramic filter and transferring the deposited material to a polymer surface, or substrate.

De Heer does not explicitly teach that the process is used to align single-walled carbon nanotubes, however, it would have been obvious to one of ordinary skill at the time of invention to apply the treatment of de Heer et al. on a sample of single-walled nanotubes, in order to align them to a substantially parallel orientation. for optimal electronic effect.

Regarding claims 136-137, It is held that a nanotube must be of the (n, n) or (m, n) helicity index. A mix is expected to occur due to what is known about growth conditions; areas of predominantly (n, n) as well as areas of predominantly (m, n) are therefore expected to occur in arrays formed by the method of de Heer et al.

Claims 126, and 128-132 are rejected under 35 U.S.C. 103(a) as being unpatentable over de Heer et al. as applied to claim 124 above, and further in view of Ge et al. ("Scanning tunneling microscopy of single-shell nanotubes of carbon").

Ge teaches single-walled carbon nanotubes having a homogenous diameter of 1 nm (+ or – 0.1 nm) and having lengths of about 20 nm. It would have been obvious to one of ordinary skill at the time of invention to apply the treatment of de Heer et al. on the single-walled nanotubes of Ge et al., in order to align them to a substantially parallel orientation. for optimal electronic effect.

Claim 133 is rejected under 35 U.S.C. 103(a) as being unpatentable over de Heer et al. as applied to claim 124 above, and further in view of Green et al. (US 6,090,363).

De Heer does not teach a single-walled nanotube having an endohedral modification.

Green teaches a process whereby nanotubes are treated and purified in nitric acid. Green additionally teaches that materials, such as a variety of metals, may be endohedrally added to the nanotubes during the purification process.

Green et al. does not explicitly teach that the process be used for the purification of single-walled nanotubes, however, it would have been obvious to one of ordinary skill at the time of invention to perform the treatment of Green et al. on single walled nanotubes, in order to remove impurities and introduce endohedral species prior to alignment.

Claim 120 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kiang et al. with Zhang et al. as applied above and further in view of Hiura et al (US 5,698,175) with Sen et al. ("Structures and Images of Novel Derivatives of Carbon Nanotubes...") to show a state of fact.

Neither Kiang nor Zhang teaches bundles containing a single-walled nanotube having a substituent on the end.

Hiura teaches a process for the purification of carbon nanotubes. The process comprises treating the nanotubes with an aqueous oxidizing agent, such as nitric acid, in solution. The nanotubes are dispersed into the solution and heated in order to selectively react the carbon impurities to dissolve in the liquid phase. The nanotubes are then separated from the liquid by filtering, washing, and drying. Hiura does not explicitly teach that the process be used for the purification of single-walled nanotubes, however, it would have been obvious to one of ordinary skill at the time of invention to apply the treatment of Hiura on a sample containing bundles of single-walled nanotubes, in order to remove impurities.

Sen et al. teaches that when nanotubes are reacted with nitric acid or other oxidizing agents, such reactions are known to result in functional groups, especially –COOH, at the tips

(page 493). Substituent groups inherently exist on the ends of nanotubes treated by the process of Hiura et al.

Claim 121 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kiang et al. with Zhang et al. as applied to claim 112 above, and further in view of Green et al. (US 6,090,363).

Green teaches a process whereby the nanotubes are treated and purified in nitric acid. Green additionally teaches that materials, such as a variety of metals, may be endohedrally added to the nanotubes during the purification process.

Green et al. does not explicitly teach that the process be used for the purification of single-walled nanotubes, however, it would have been obvious to one of ordinary skill at the time of invention to perform the treatment of Green et al. on a sample containing bundles of single walled nanotubes, in order to remove impurities and introduce endohedral species.

Allowable Subject Matter

Claim 134 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 125, 135, 138, and 140 are allowed. The following is a statement of reasons for the indication of allowable subject matter: Prior art neither teaches nor suggests the binding of single-walled carbon nanotubes to substrates through the chemical interaction of linking moieties.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter J Lish whose telephone number is 703-308-1772. The examiner can normally be reached on 9:00-6:00 Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 703-308-3837. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

PL

STUART L. HENDRICKSON
PRIMARY EXAMINER